CHEMICALS
Project Fact Sheet

Tackifier Dispersions to Make Pressure Sensitive Adhesives

Benefits

- 70% reduction of thermal energy requirements
- Energy savings of 1.2 trillion Btu energy by 2020
- Reduced mixing time from 4 hours to a few minutes

Applications

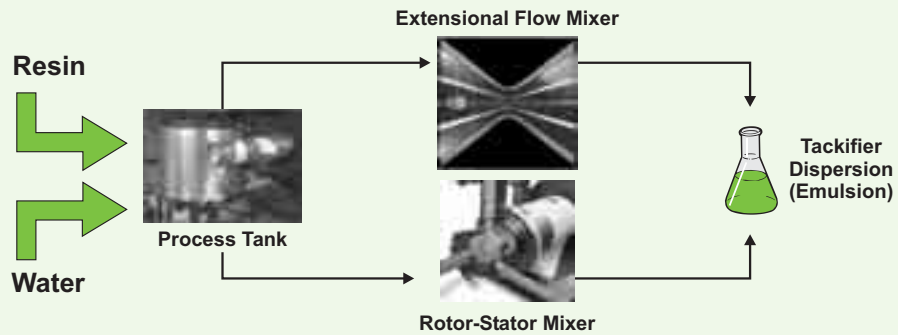
The adhesives industry uses pressure sensitive adhesives in a wide range of products. Common applications are removable note pads and self-adhesive postage stamps. PSAs can be made to adhere to different surfaces by the application of finger or hand pressure.

Development of New Processes for Tackifier Dispersion Could Improve the Production of Pressure Sensitive Adhesives

Pressure sensitive adhesives (PSAs) have the ability to adhere to different surfaces with manual or finger pressure. PSAs are made by combining a tackifier dispersion with a latex dispersion. The tackifier is an oil-in-water emulsion that allows the latex dispersion to function as an adhesive. The world-wide volume of PSA production exceeds 2.55 million tons, and the estimated total U.S. market for adhesives is approximately $10 billion dollars. The process of making tackifier dispersions is highly energy intensive. The resultant formulated adhesives contain approximately 50 percent water. When the adhesives are coated onto label stock, the water is removed by drying with radiant heaters. Consequently, in addition to the tackifier emulsification process, a large amount of additional energy is consumed by shipping of large amounts of water contained in the adhesive products and also by the radiant heating drying processes. Given the large PSA production volumes, there is an opportunity for significant energy savings that could be achieved through the development of higher efficiency manufacturing processes.

Improvements in the PSA manufacturing process could improve operations with a focus on better management of the supply chain, improve efficiency in the use of raw materials and energy use, and provide environmental benefits by employing water-based methods instead of solvent-based methods. Energy savings are estimated at 1.2 trillion Btu by 2020. These savings can be achieved by eliminating the need to melt the resin and to stir the emulsion for several hours. The use of a concentrated emulsion translates to a reduction in the amount of water that has to be transported offsite and the water that has to be removed when the adhesive is coated onto a tape or label. Additionally, the use of high softening point resins implies that the resulting PSA will be able to displace solvent-based adhesives, thereby providing a benefit to the environment.

Dispersion Production Process



Proposed process for the synthesis of tackifier dispersions used in the formulation of pressure-sensitive adhesives.

Project Description

Goal: To develop an energy efficient process for making commercial-quality tackifier dispersions.

The current process for tackifier dispersion manufacture begins by melting the resin to form a water-in-oil emulsion, which is then converted to an oil-in-water emulsion by phase-inversion in the presence of continuous stirring. The resulting emulsion is not concentrated and the remaining excess water has to be transported and removed.

The main barrier to overcome in the development of commercial quality tackifier dispersions is the inability to directly emulsify resin in water. The viscosity of the resin phase is so large compared to the aqueous phase that resin droplets cannot be broken down to small sizes by the shear stress transmitted by the water phase. Possible solutions to circumvent this barrier include (i) the use of mixers that do not use strictly laminar shear flow and perhaps also generate turbulence, (ii) mixers that employ an extensional flow field that is not limited in effectiveness by the ratio of the dispersed phase viscosity to the continuous phase viscosity, (iii) reducing the resin to a powder form with the correct size and size distribution before dispersion in water, and (iv) direct emulsification of the tackifier resin in the latex dispersion without the intermediate step of formulating a tackifier dispersion.

Progress and Milestones

The project plan is divided into five tasks as outlined below.

- Improvement of the current process
- Direct emulsification of resin in water using an Extensional Flow Mixer
- Comminution of resin followed by emulsification
- Single-step synthesis of PSAs
- Rheological Characterization

Commercialization

Two project partners, Mays Microsystems and Charles Ross and Son Company, are participating in the project with the sole purpose of commercializing the new technology and making it available as widely as possible.

Project Partners

West Virginia University
Morgantown, WV

Dyna-Tech Adhesives, Inc.
Grafton, WV

Charles Ross & Son Company
Hauppauge, NY

Mays Microsystems, Inc.
Millburn, NJ

Argonne National Laboratory
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Tulane University
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